Possible modes of operation of CMS−QIE

(1) Use non−inverting mode of QIE: 2.6 fC/count. No practical limit on maximum charge/channel

(2) Use calibration mode of QIE: ~1 fC/count. Maximum charge/channel of ~30 fC.

(3) Place inverting 10x amplifier infront of QIE, and use inverting−mode of QIE: ~ 0.1 fC/count. No practical limit on maximum charge/channel.

We simulate how well we can reconstruct the beam shape under the following constraints:

(1) It is hard to predict the noise level. So we simulate over a wide variety of noise levels

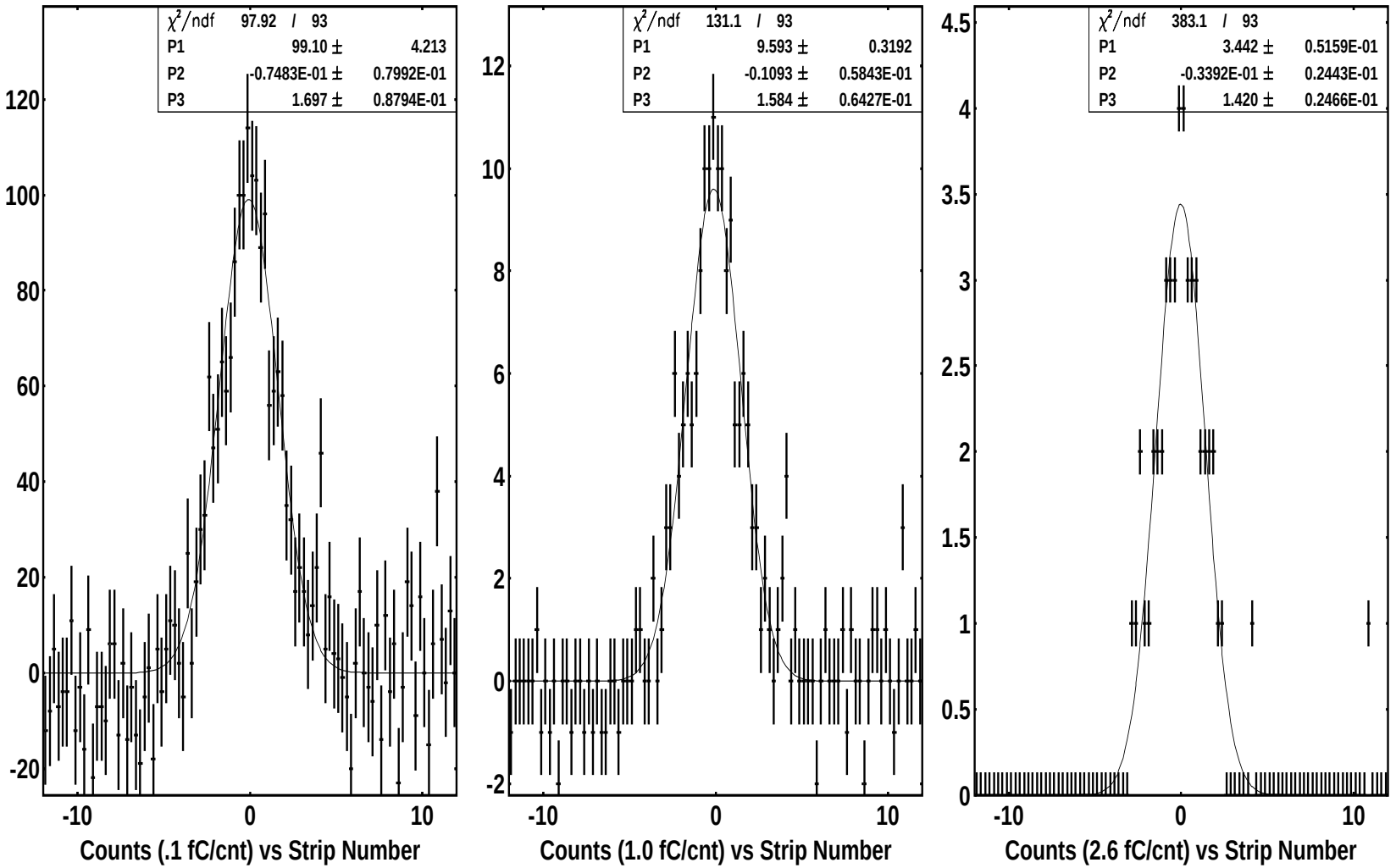
(2) The beam width varies from 1.7 mm (at TeV injection) to 0.5 mm (at flattop)

(3) The pbar beam amplitude is smaller than protons by ~10x. So we will have to perform a digital sum of many pbar bunches to get adequate resolution.

(4) Typical parameters:

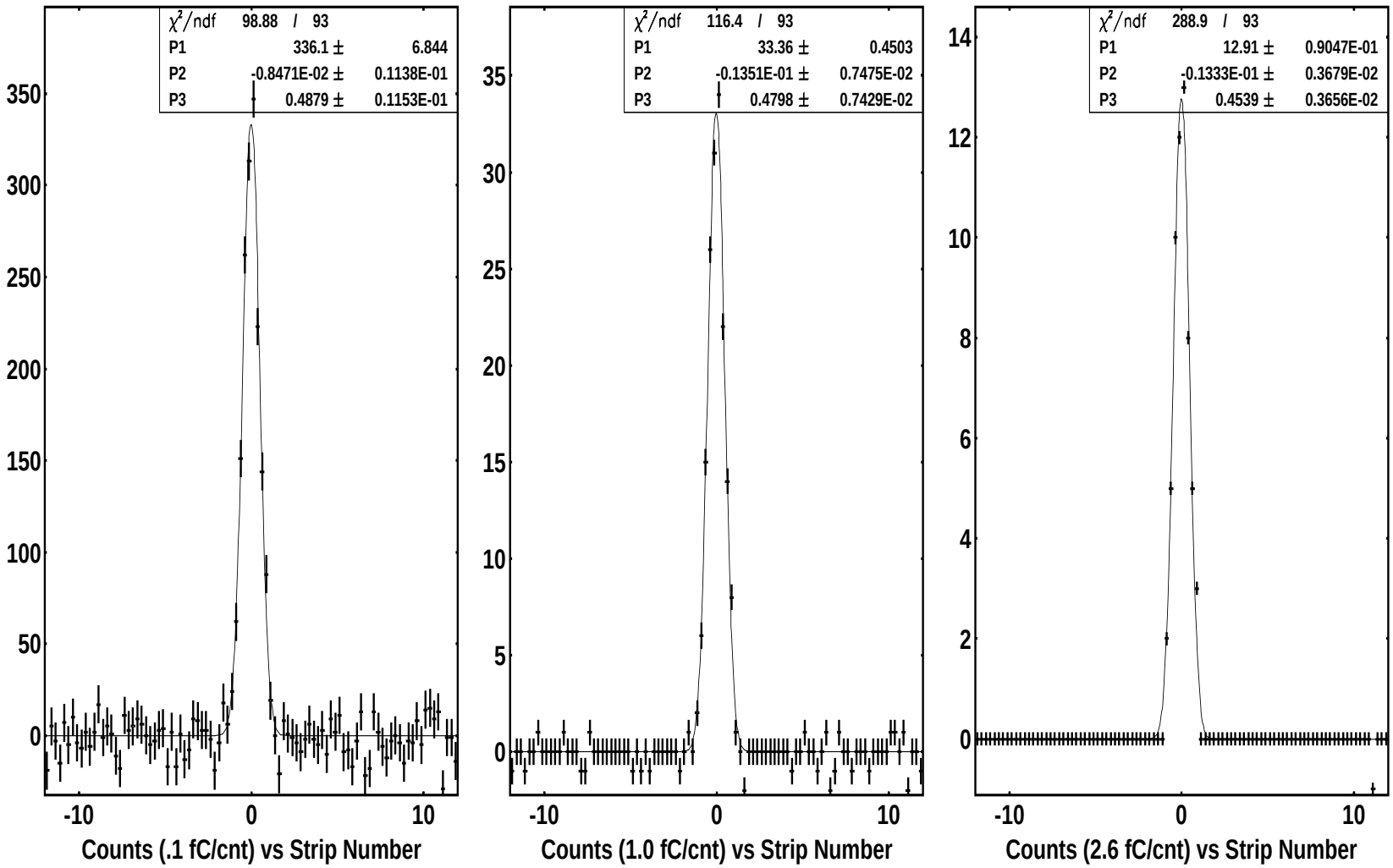
Number of primary ionizations/bunch: 1000 (p), 100 (pbars)
Microchannel plate gain = 1000
(Assume no gain fluctuations and 100% efficiency)
Anode strip width = 0.25 mm

Example: protons at injection (1.7 mm bw), Noise=6500e, 1 Sample



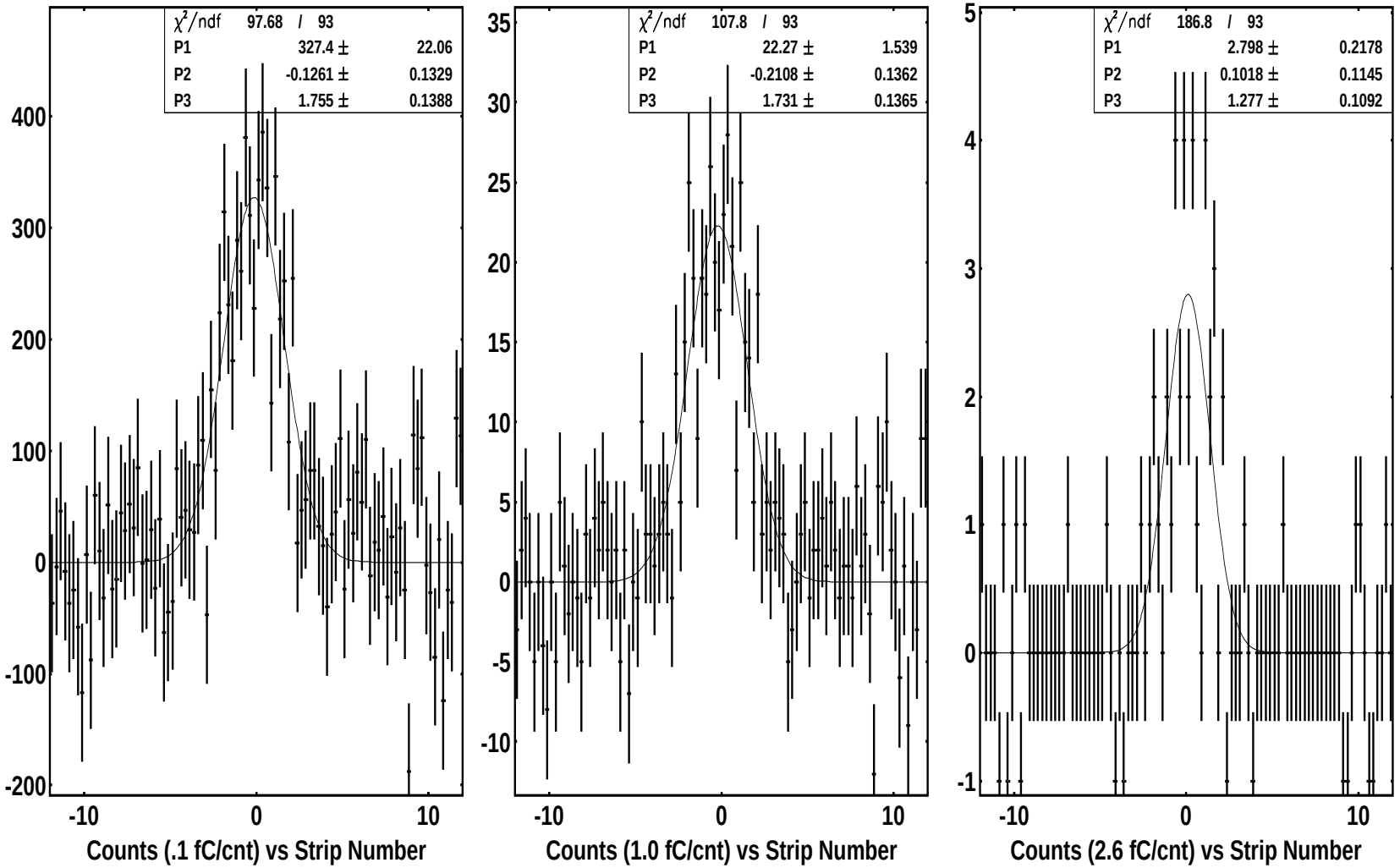
Note: Errors on the gaussian peaks not quite correct.

Example: protons at flattop (0.5 mm bw), Noise=6500e, 1 Sample

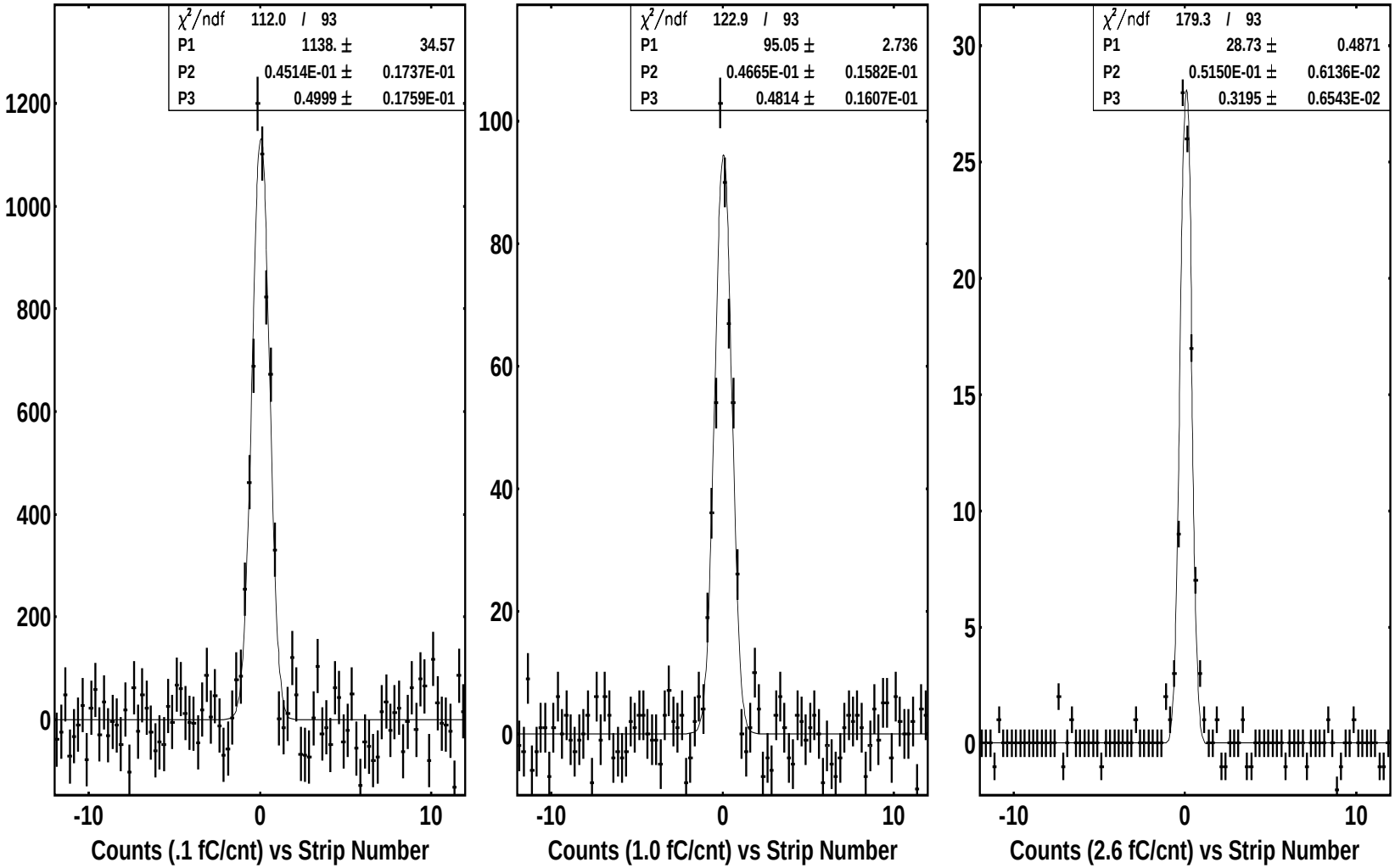


This operation nearly saturates QIE calibration mode

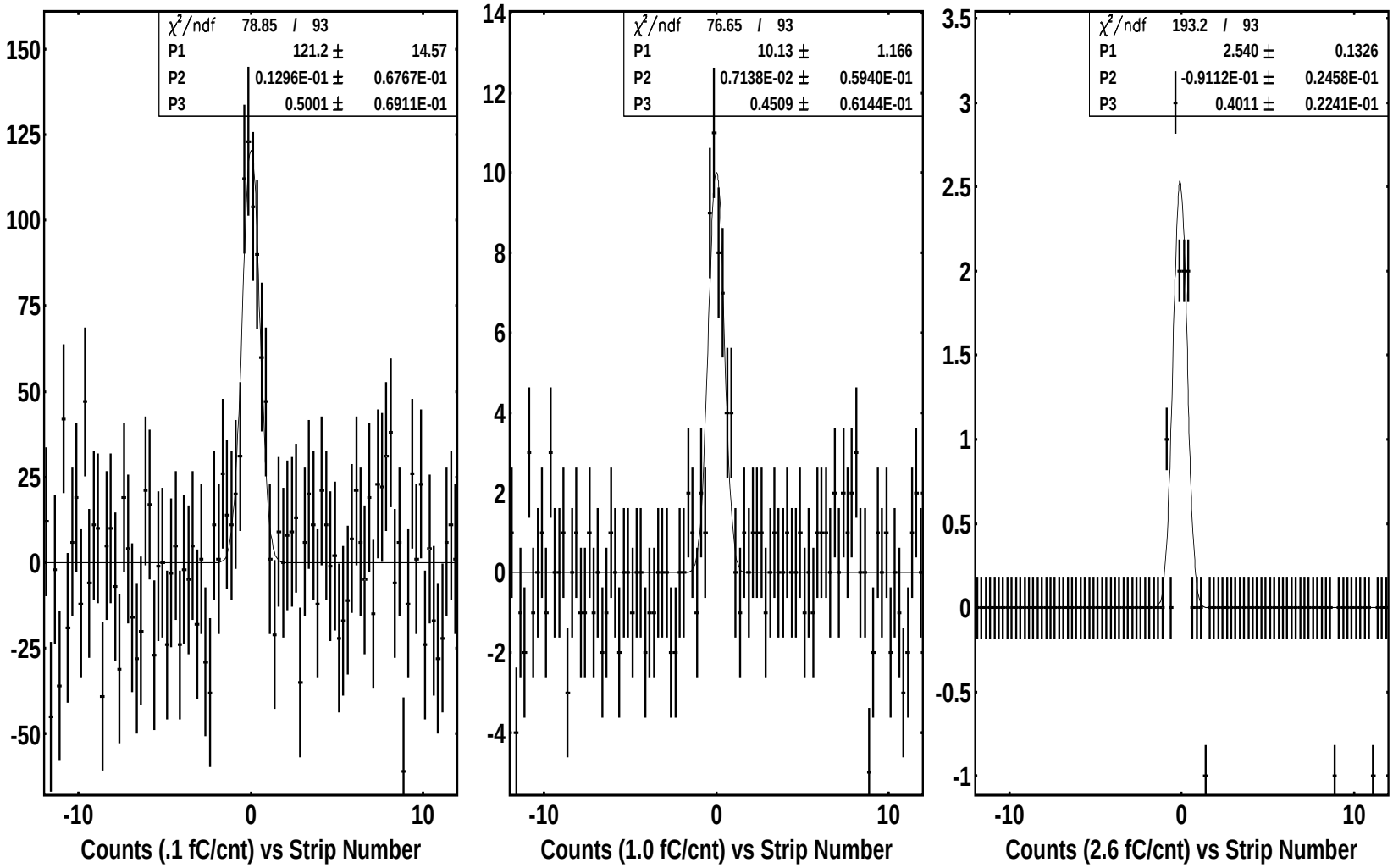
Example: pbars at injection (1.7 mm bw), Noise=6500e, 36 Samples



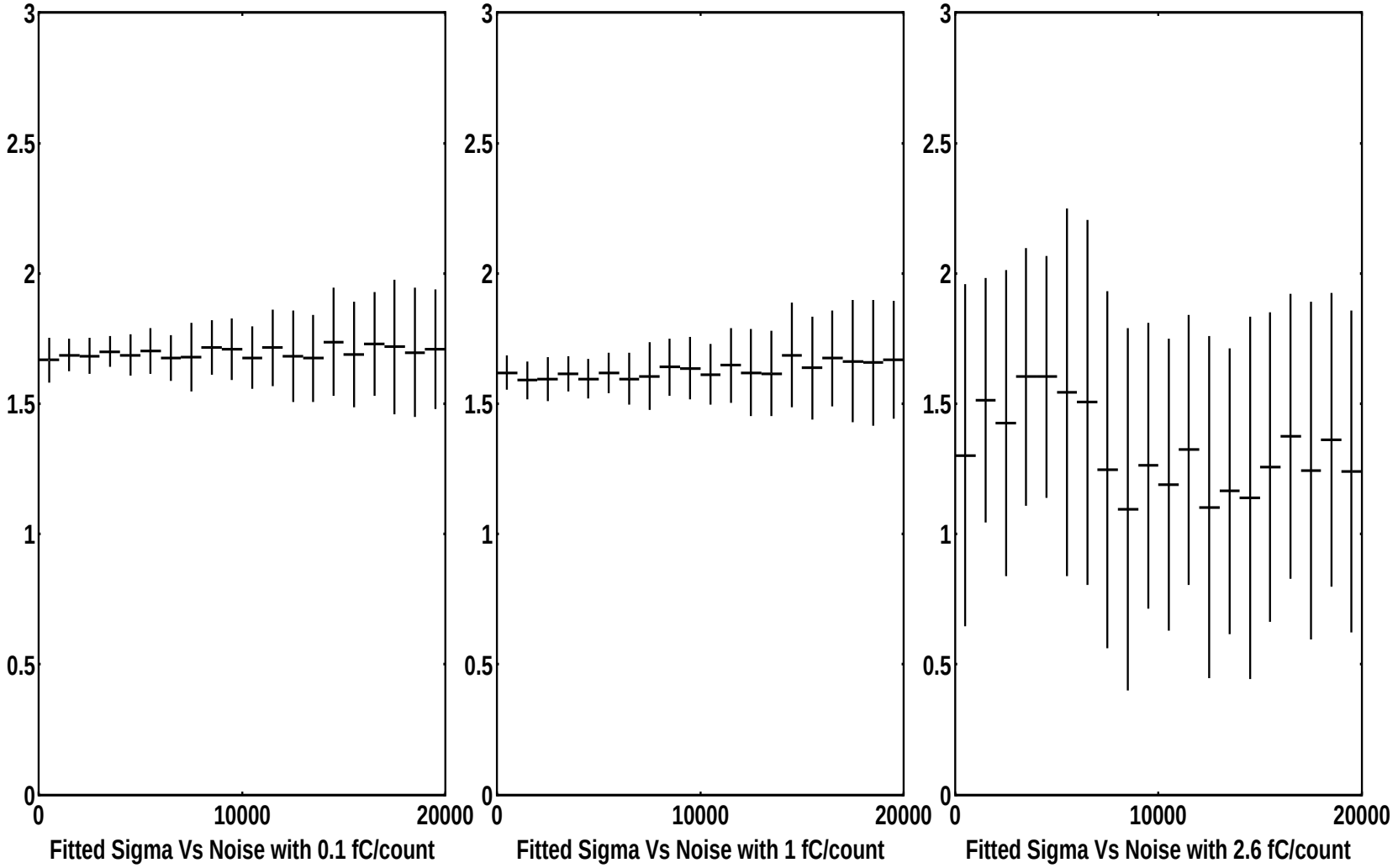
Example: pbars at flattop (0.5 mm bw), Noise=6500e, 36 Samples



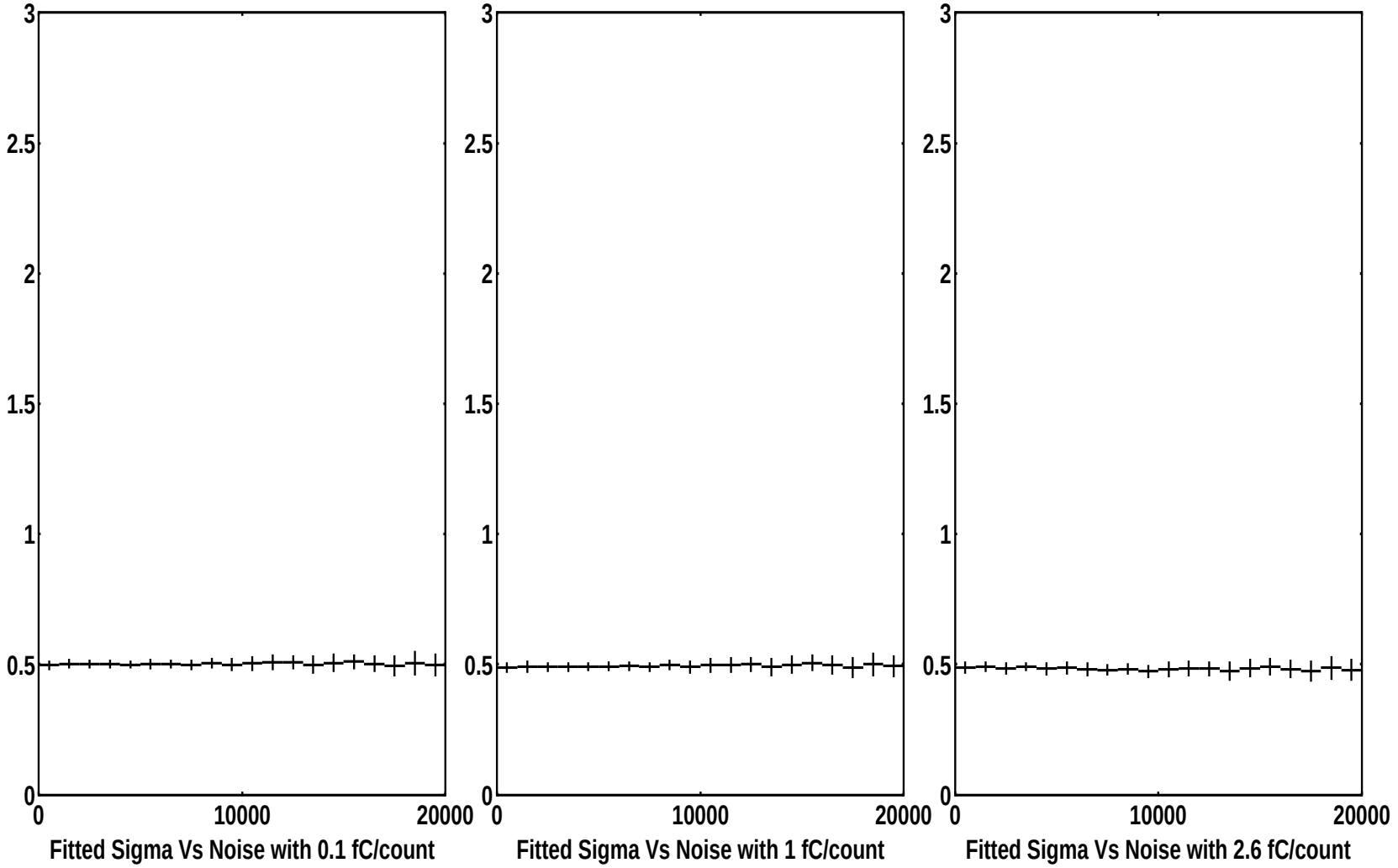
Example: pbars at flattop (0.5 mm bw), Noise=6500e, 4 Samples



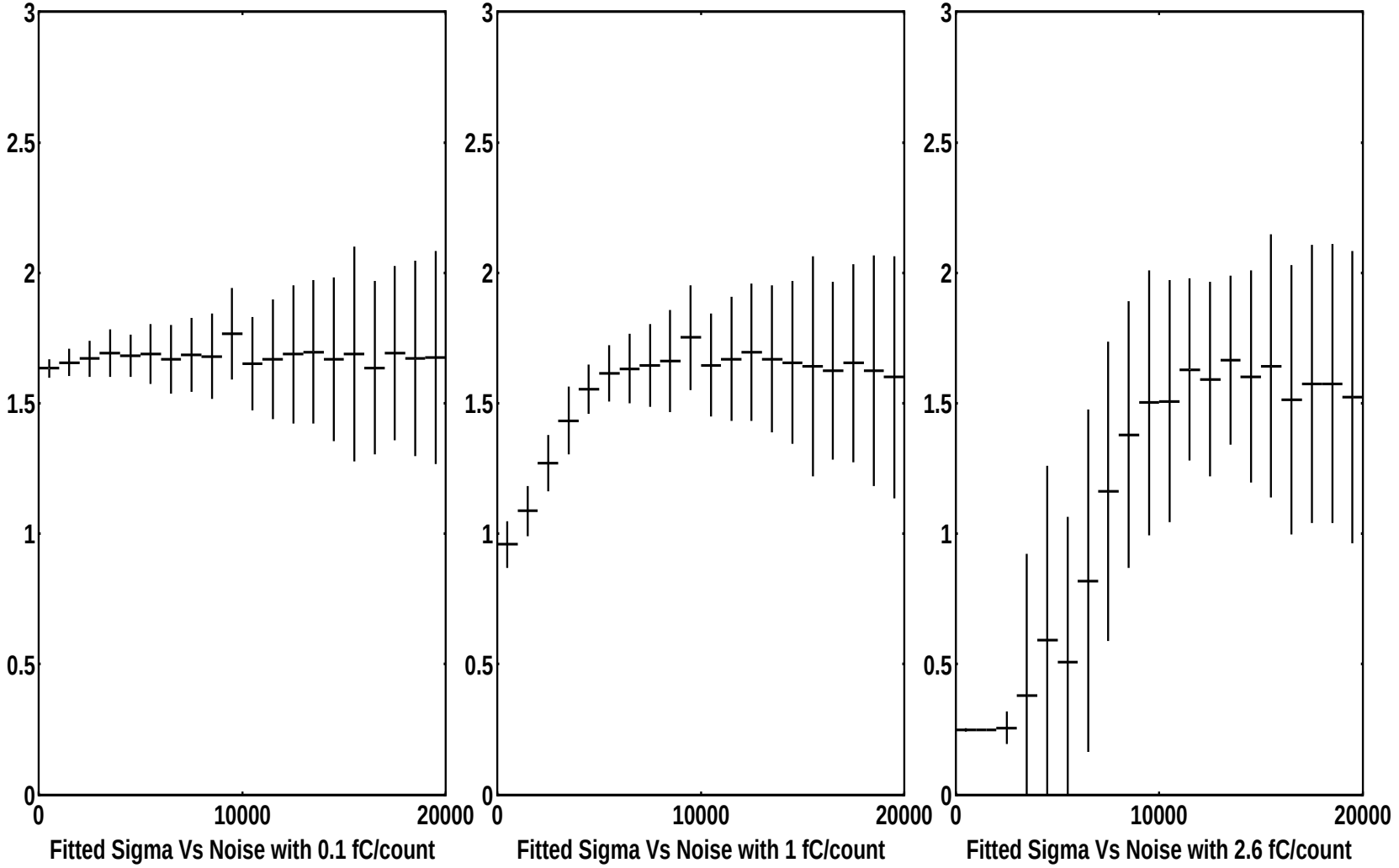
Fitted beamwidth (mm) versus electronic noise
for protons at injection (1.7 mm bw), 1 samples



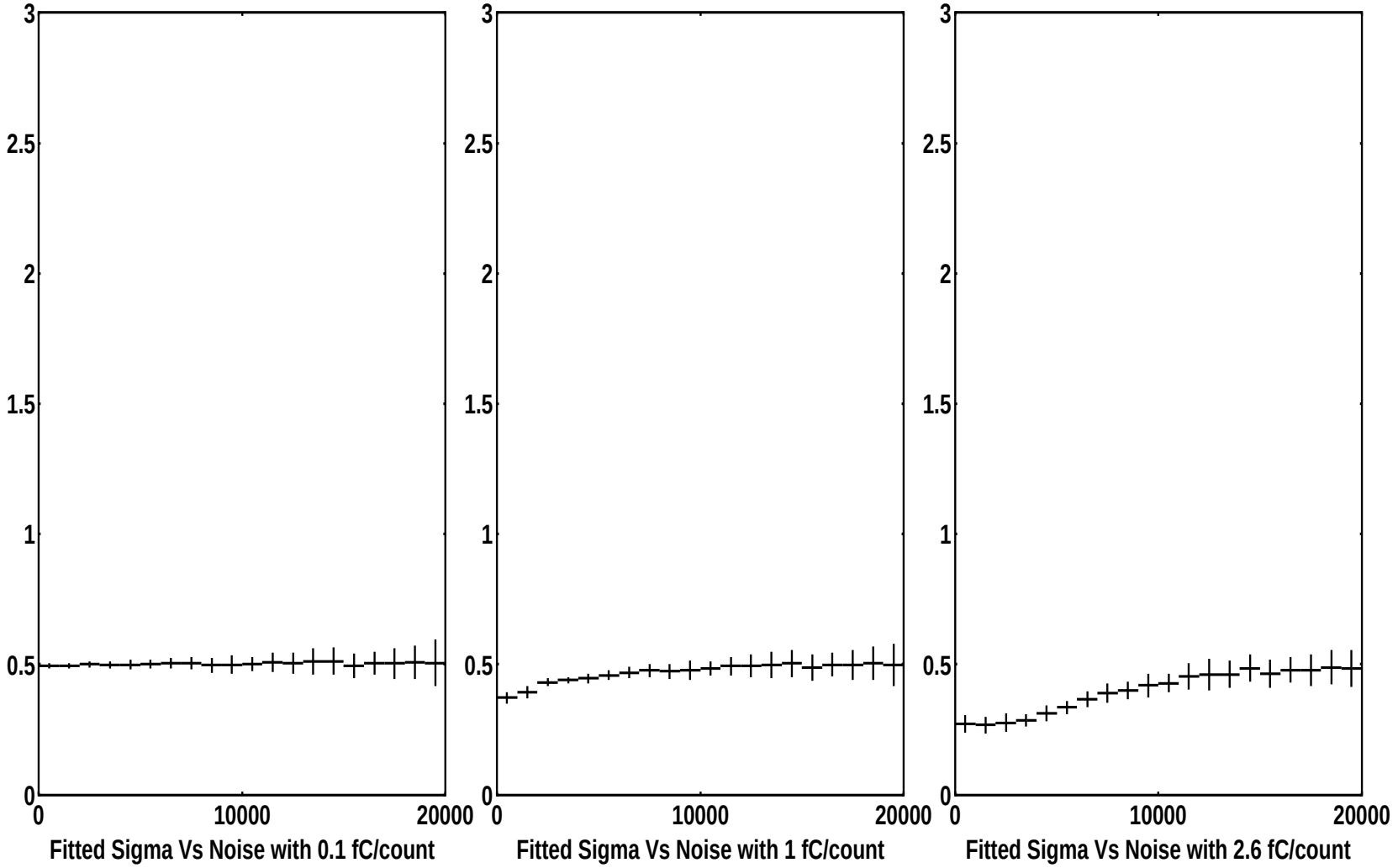
Fitted beamwidth (mm) versus electronic noise
for protons at flattop (0.5 mm bw), 1 samples



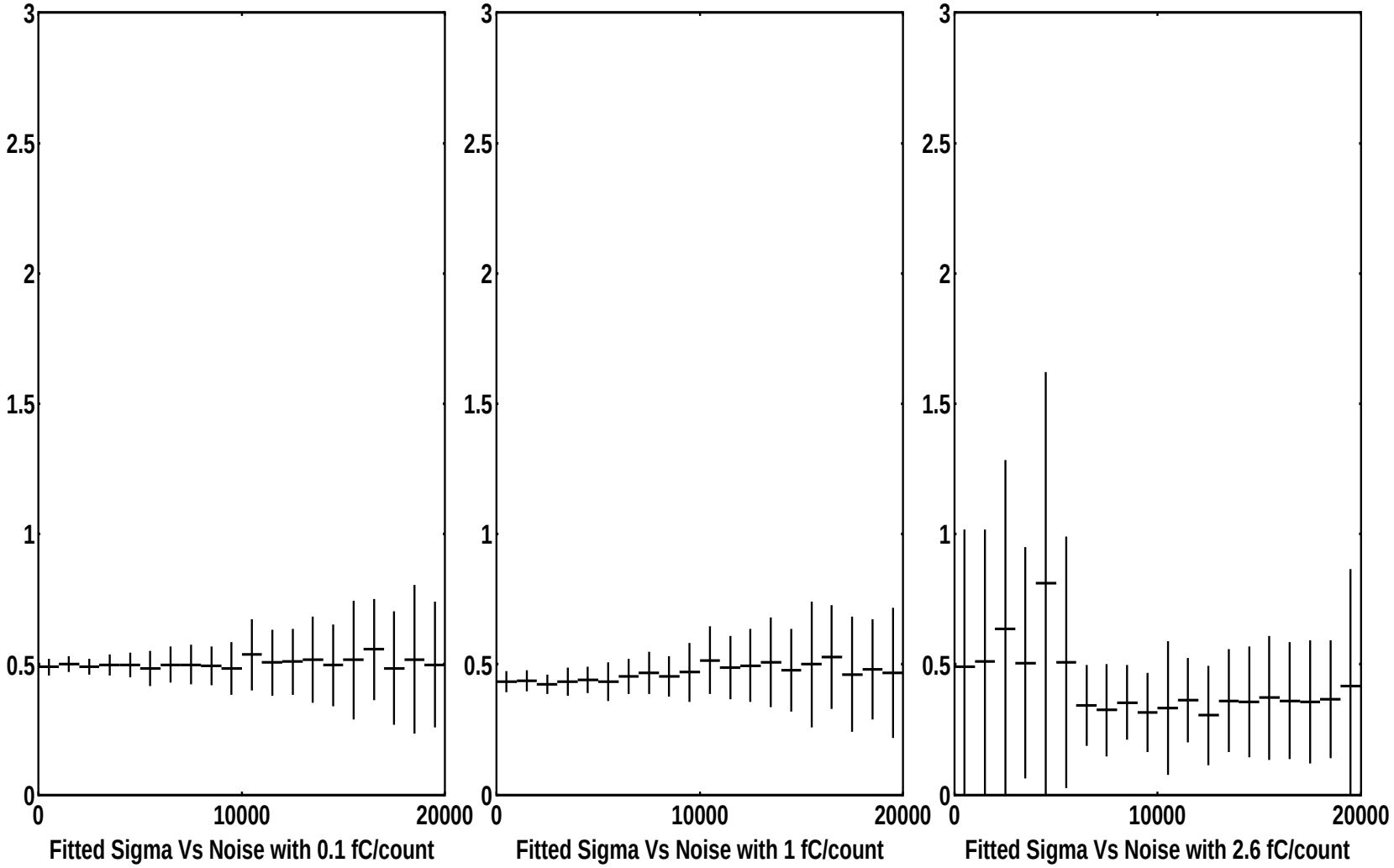
Fitted beamwidth (mm) versus electronic noise
for pbars at injection (1.7 mm bw), 36 samples



Fitted beamwidth (mm) versus electronic noise
for pbars at flattop (0.5 mm bw), 36 samples



Fitted beamwidth (mm) versus electronic noise
for pbars at flattop (0.5 mm bw), 4 samples



QIE versus SVX3

The SVX3 appears to have the correct sensitivity, polarity, and noise performance that we need.

However, we need the higher rate capability of the QIE. We need digitized output from every bucket, especially during TeV injection.

We'd be using the SVX3 not in the way that it was intended, so more R&D is needed to know for sure if it would work.

The QIE is a known quantity. And our CMS colleages believe they have sufficient spares for our needs (~200). They are willing to give us ~ 20 production QIEs now.

Conclusion

- QIE in calibration mode appears to have the sensitivity we need.

- QIE with an 10x inverting amplifier is slightly better and has less "control" overhead. Being able to measure the pedestal rms accurately will probably improve our fits and chi2's.

- Radiation tolerance issues may force us to use preamps

- We can tolerate noise between 6000e and 10000e. We still need to do more homework to specify cabling and shielding from MCP to QIE.

The TeV IPM, with this kind of FE, would fill a unique role in TeV monitoring. It is would be the only device that measures the beam profile during the critical period of TeV injection and ramping.

We now need coordinated and substantive help on this project:

- We would like to ask Ray's group for a prototype FE board containing 8 QIE's and a prototype board containing 8 preamps.

- We would like Vince's group to suggest and prepare a DAQ system to readout the QIE boards.

- We are near completion of vacuum teststand dedicated to MCP's. This is a natural place to tryout these prototype boards.